

# Automobiles

## Playing around with P equals VI

### Tesla Cybertruck: first to transition from 12V to 48V architecture

Tesla (TSLA US, CMP: USD 237, **Not Rated**) Cybertruck is first vehicle globally to replace the entire 12-volt (V) electrical system with 48V electric & electronic (E&E) architecture. This is basically playing with the power equal to voltage multiplied by current equation ( $P = VI$ ). As the amount of power needed with more features increases in a vehicle, for a constant 12V architecture the current needed increases significantly; hence, thicker wiring harness and copper content were the need of the hour. TSLA replaced the entire 12V architecture with 48V, reducing the current needed for the same power output, thereby sharply lowering the wiring harness content. The company claims the wiring harness content and weight fell ~75%. We shared the detailed specifications and features in our note, [Cybertruck launch](#) on 1 December 2023.

### What's in it: advantages of the 48V architecture

A 48V architecture will reduce weight and thickness of cables by ~75%, and copper requirement by 50% while increasing efficiency and cost savings. The system change further embraces the removal of hardware component control systems, such as relays and fuses and replaces them with software control over ethernet. It will reduce current by a factor of 4x compared to 12V systems, bringing the current to safer levels.

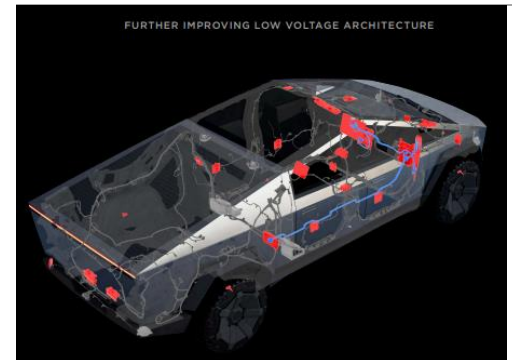
### Our view: technological risks exist; reiterate Reduce on MSWIL

While mass-scale adoption of 48V architecture replacing the 12V one is still some time away, TSLA is able to make a breakthrough, meaning it is about time that global firms start to evaluate this option seriously. Elon Musk has sent the 48V architecture implementation documents to all major CEOs which Ford's CEO Jim Farley has acknowledged on X.com. Our industry interactions indicate the EV wiring harness content globally is ~1.5x the ICE wiring harness content (in India, it is ~2x owing to import content). Our back of the envelope calculations along with industry participants interactions indicate in 48V architecture the wiring harness content could come off closer to 1.0x of ICE from 1.5x that it is currently (the high voltage wiring from battery to motor etc remains intact while the 12V wiring harness sees a significant reduction). However, the number of players entering this electrical distribution system (EDS, which wiring harness is part of) could significantly increase as wiring harness becomes a part of the entire EDS. This can have long-term market share implications for existing players.

The replacement of 12V with 48V also eliminates the lead acid battery. However, large part of de-rating of lead acid battery players like Amara Raja Energy and Exide Industries had played out when TSLA replaced the 12V lead acid battery with a 12V Li-ion battery in Model 3 and Y.

For MSWIL, we believe such technological evolution globally and it being a single product, single geography company will keep multiples under check, which is currently at 37x/32x FY25E/26E P/E, even as it has potential of market share gains and content per vehicle increase in the short term. We reiterate our **Reduce** rating on MSWIL with a TP of INR 57 based on 30x December 2025E EPS of INR 1.9.

### Cybertruck's 48V architecture reduces wiring needs compared to 12V system



Source: Tesla Investor Day 2023, Elara Securities Research

### Motherson Sumi Wiring India valuation

(x)	FY23	FY24E	FY25E	FY26E
P/E Ratio	56.3	45.0	37.2	31.7
EV/EBITDA	35.1	28.5	24.2	20.8
Price/Book	20.6	17.4	14.7	12.4

Source: Company, Elara Securities Estimate

### Amara Raja Energy & Mobility valuation

(x)	FY23	FY24E	FY25E	FY26E
P/E Ratio	17.5	14.8	13.8	12.8
EV/EBITDA	9.5	8.3	7.5	6.8
Price/Book	2.5	2.1	1.9	1.7

Source: Company, Elara Securities Estimate

### Exide Industries valuation

(x)	FY23	FY24E	FY25E	FY26E
P/E Ratio	26.8	22.3	18.2	15.6
EV/EBITDA	15.6	12.9	10.8	9.2
Price/Book	2.2	2.1	1.9	1.7

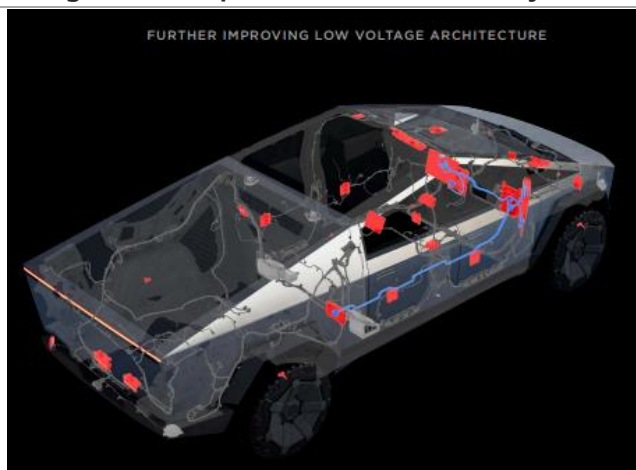
Source: Company, Elara Securities Estimate

## Automobiles

### Cybertruck – first of its kind

TESLA Cybertruck is the first-ever automobile to completely replace the 12V architecture by 48V architecture. All future TSLA vehicles and Optimus will adopt the 48V architecture. Multiplexing via ethernet ring for in-vehicular communications, has reduced the wiring harness requirement overall, leading to a 78% reduction in weight for TSLA. Ethernet allows a much higher data rate than the traditional CAN bus, thereby reducing the number of point-to-point wires due to higher bandwidth. This also enables implementation of steer-by-wire system. The company has 48V, ethernet, and CAN bus on the same cable to connect all components in daisy chain. All future TSLA vehicles and Optimus will adopt 48V architecture.

### Exhibit 1: Cybertruck's 48V architecture reduces wiring harness requirement to 25% of 12V system



Source: Tesla Investor Day 2023, Elara Securities Research

### What is the 48V architecture?

The 48V system allows for more effective power distribution and management of increased electrical loads using smaller, less intricate wiring. Higher voltage is needed to reduce resistance losses, thereby lowering heating of wires, resulting in thinner wires and greater gains in efficiency.

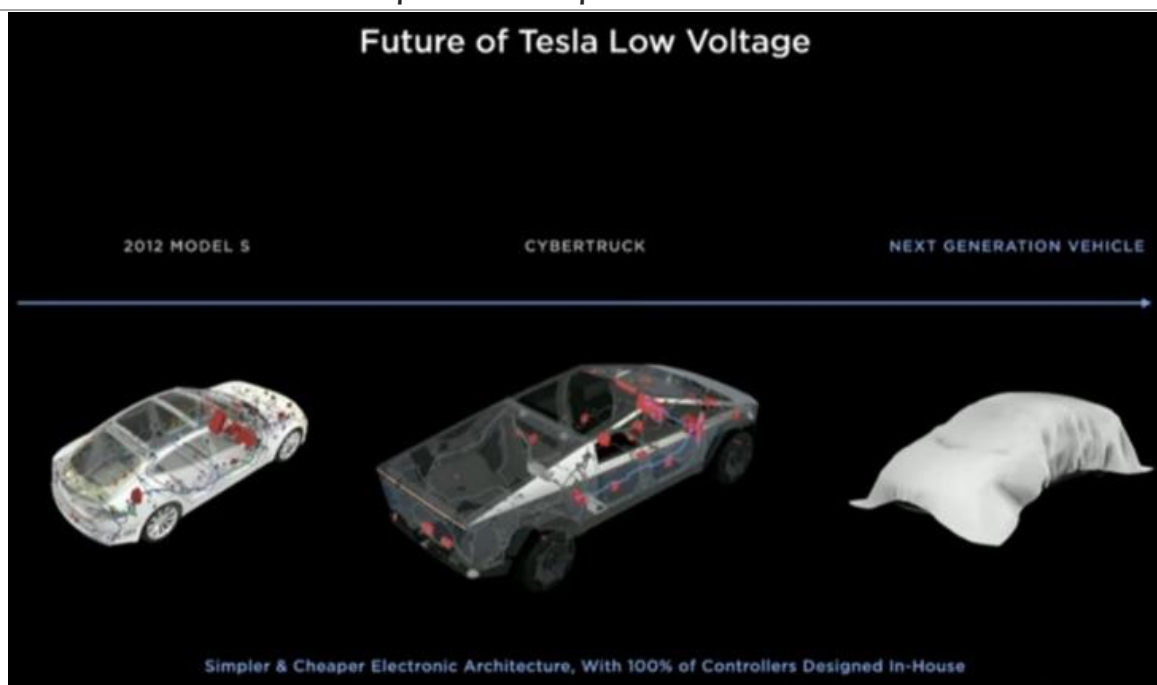
Increased electrical capacity of a 48V system enables the integration of advanced features and technologies, such as electrically assisted steering, such as steer-by-wire systems, and advanced driver assistance systems (ADAS).

With the existing 12V architecture in most passenger vehicles, it is unrealistic and inefficient to try to drive loads of this magnitude, as the current involved will be in the hundreds of amperes. Losses in wiring and static losses in semiconductors are proportional to the square of the current; hence, with a 12V approach, overall vehicle efficiency would be significantly reduced.

Moving to a 48V zonal architecture presents an opportunity enabled by Ohms Law (Power = Current x Voltage). For the same power delivery, a 12V source requires 4x as much current as a 48V. Thus, the 12V wire is usually four times thicker than a 48V wire.

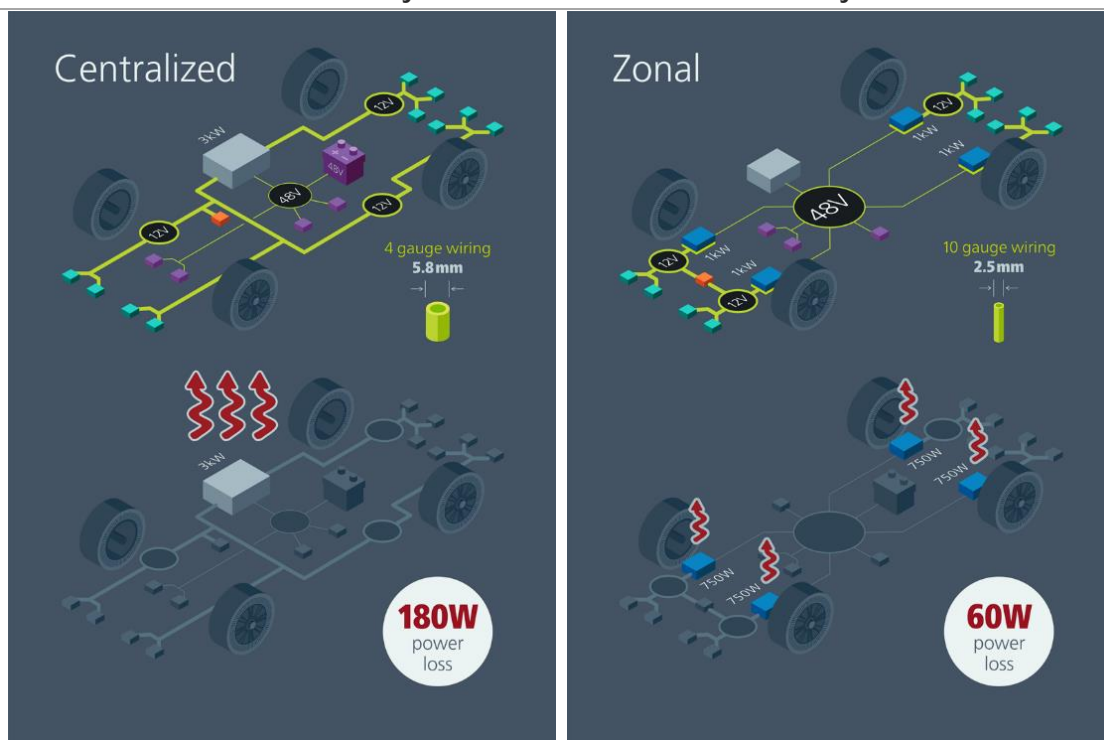
Implementing a zonal architecture with robust support from high-density power modules offers a threefold reduction in weight: 1) the 48V innovative architecture facilitates a shift from bulky wire harnesses to slimmer ones, resulting in ~75% reduction in harness weight, 2) the removal of low-voltage auxiliary batteries is made possible by virtualizing them with power modules,

### Exhibit 2: All future TSLA vehicles and Optimus will adopt 48V architecture



Source: Tesla Investor Day 2023, Elara Securities Research

**Exhibit 3: Centralized architecture in 12V systems vs zonal architecture in 48V systems**



Source: powersystemsdesign.com, Elara Securities Research

eliminating the weight associated with the batteries, 3) the Power Delivery Network (PDN) upgrade utilizing power modules optimizes the thermal management system, leading to a ~33% reduction in its weight, as suggested by industry reports.

**12V vs 48V – what’s the difference?**

The 12V architecture is becoming a bottleneck in the face of rapid technological leap in the automotive space. The low voltage is adding to complexity of delivering adequate power to all vehicle systems that need electricity and complicating wiring layouts with addition of more electrical components.

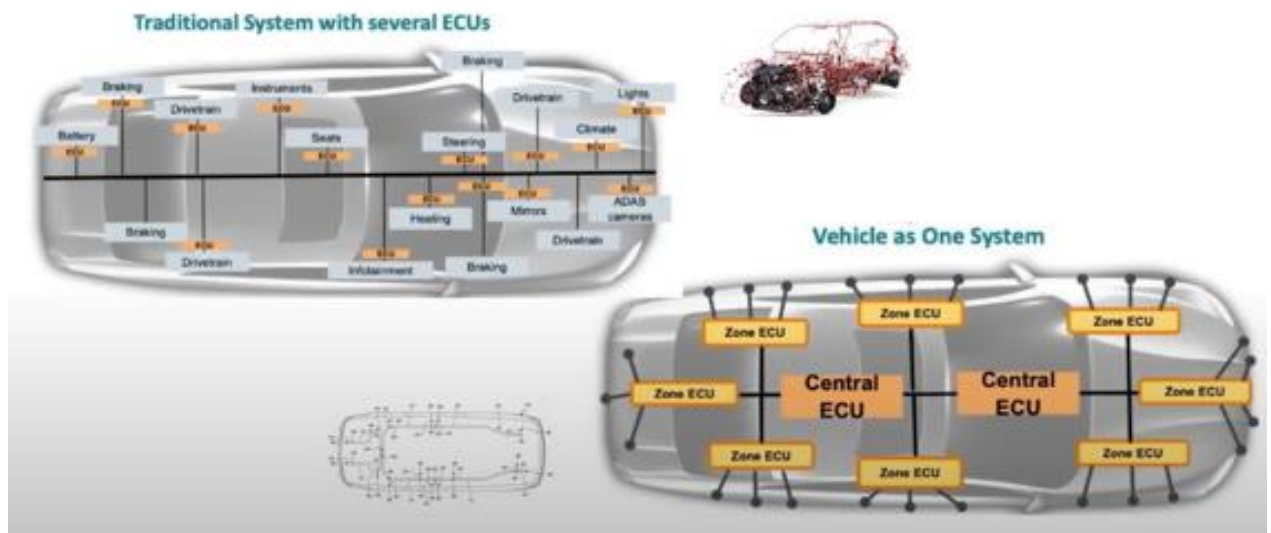
*While 48V systems have been partly utilized in hybrid vehicles (in tandem with 12V system) for a few years, the Cybertruck replacement of the traditional 12V system is a significant step forward for the auto industry.*

**Exhibit 4: Following are differences between 48X and 12V system**

Nature	48V architecture	12V architecture
Voltage	Operates at 48 volt	Operates at 12 volt
Power delivery	Allows for higher power delivery, supporting additional components and systems.	Standard power delivery for traditional automotive systems.
Battery type	Lithium-ion chemistry	Lead acid chemistry
Efficiency gains	Reduces power losses in wiring and components, leading to overall efficiency gains	Lower voltage may result in higher power losses
Wiring size & weight	Enables use of smaller and lighter wiring. (10-gauge wires at 27g/m – ~80% lower)	Wiring may be larger and heavier due to the lower voltage. (4-gauge wires at 273g/m)
Power box housing	Zonal power modules which will be 33% smaller	Centralized housing system architecture
Advanced features	Supports advanced features like electrically assisted steering, ADAS, and more	Limited capacity for advanced electrified components

Source: Collated from various media articles, Elara Securities Research

## Exhibit 5: Reinventing the traditional electric &amp; electronic (E&amp;E) architecture



Source: youtube.com, Elara Securities Research

### Key characteristics of 48V architecture

- **Increased power supply:** A 48V system allows for higher power delivery, enabling support of additional electrical components and systems
- **Efficiency gains:** Reduces current needed by a factor of four and since power loss in the harness is resistance times the square of the current, a 4x reduction in current leads to a 16x reduction in lost power. This results in reduced power losses in wiring and components, leading to overall efficiency gains in the vehicle's electrical system
- **Support for advanced features:** Increased electrical capacity of a 48V system enables the integration of advanced features and technologies, such as electrically assisted steering (steer-by-wire systems), ADAS, and other electrified components
- **Lighter wiring:** With the higher voltage, it is possible to use smaller and lighter wiring by 75% throughout the vehicle, reducing overall weight and contributing to better fuel efficiency

### Roadblocks in 48V mass adoption

Transitioning from 12V to 48V is a complex process as it necessitates the redesign of vehicle wiring and incorporation of new electrical components, including every motor, light, sensor & chip and while ensuring compatibility with higher voltage. These challenges could include issues, such as the need for new safety features to protect against electrical shock

- **Market acceptance and adoption:** Widespread acceptance and adoption by automakers may take time. Industry firms must overcome skepticism and demonstrate long-term benefits of 48V systems to encourage broader implementation
- **Integration complexity:** Integrating a 48V system into existing vehicle architecture can be complex. Compatibility issues may arise when trying to integrate it with conventional 12V components, leading to challenges in ensuring seamless communication
- **Cost involved:** Transition to 48V system will involve additional capex for development/integration of new components, upgrading manufacturing processes and adapting to the new technology, thereby dragging margin & profitability due to lack of scale
- **Global standardization:** Lack of global standardization for 48V systems may lead to differences in specifications and compatibility. Standardization efforts are essential to promote interoperability and streamline adoption of this technology across different markets

**Chicken-egg state thwarts mass adoption**

TSLA has managed to adopt the pure 48V architecture due to its strong leadership, manufacturing capability, vertically integrated supply chain and in-house development of components. Legacy OEM continue to struggle with mass adoption across product platforms (currently 48v and 12V coexist in hybrid platforms) as suppliers currently develop 12V adaptable components and would want orderbook guarantees for 48V while OEM would expect a viable working product.

Enabling this new 48V architecture requires new cables, connectors, active (power-management integrated circuits) and passive (protection device) components.

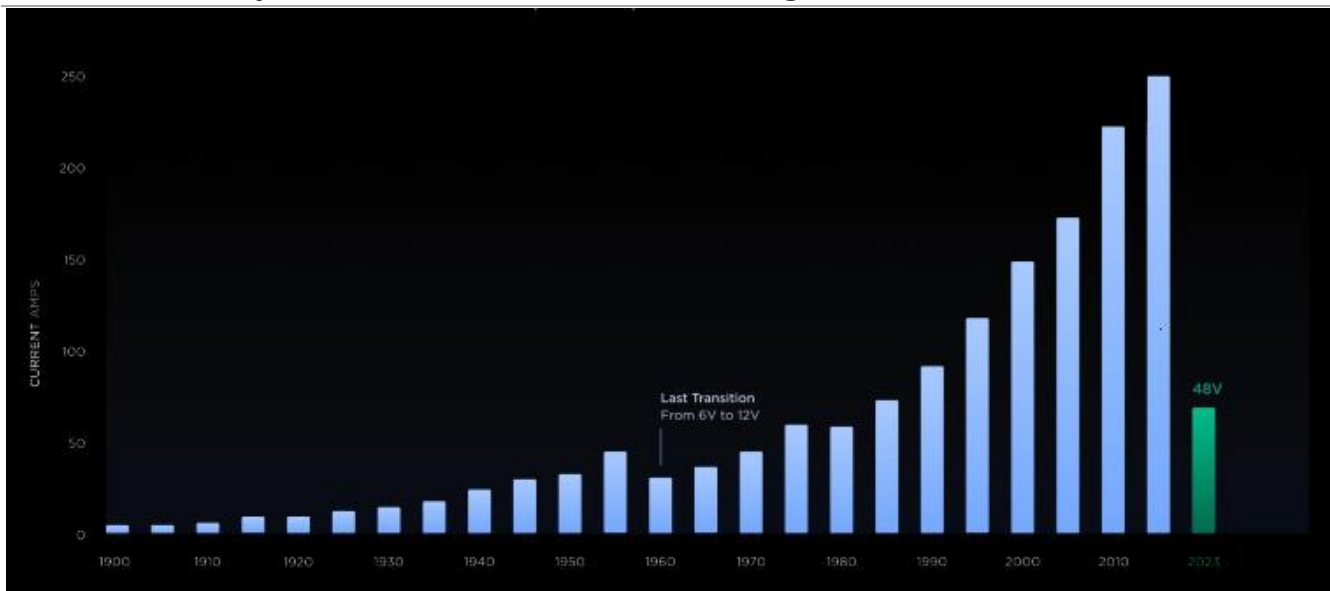
Further, cost involved in transitioning the entire ecosystem of OEM and component suppliers would be significant. Similarly, as to how TSLA transformed adoption of electric vehicles, the push for the automotive industry to transition from 12V to 48V, backed by a proven product is anticipated to yield results in the medium term in a phased manner.

**Exhibit 7: Ford’s CEO acknowledging the need for shift to 48V architecture**



Source: X.com, Elara Securities Research

**Exhibit 6: The industry to transition to 48V architecture in the long term**



Source: Tesla Investor Day 2023, Elara Securities Research

### Steer-by-wire system

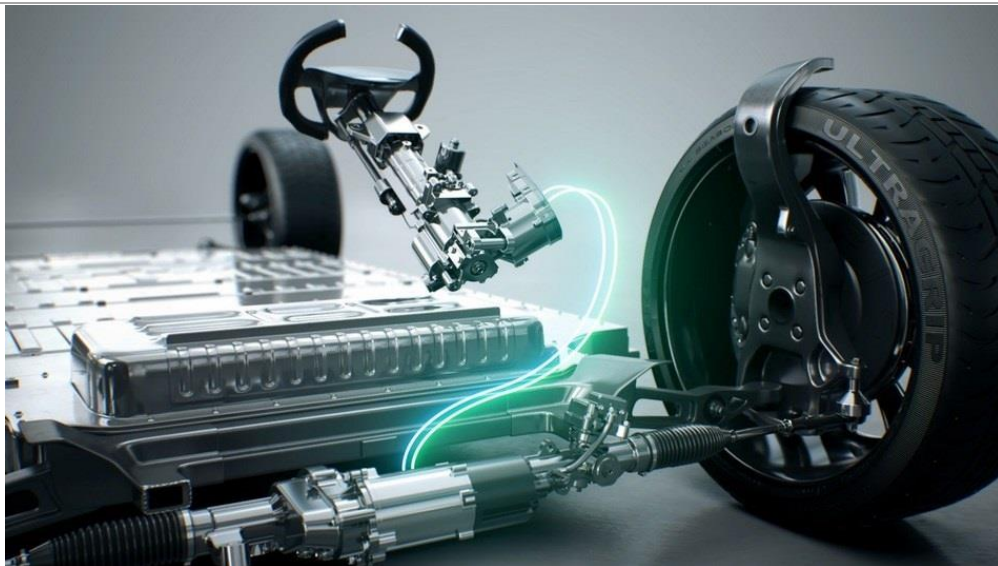
TSLA is one of the few companies to implement the steer-by-wire system, which provides drivers with enhanced maneuverability and a turning radius that rivals most sedans.

The company's steer-by-wire technology eliminates the mechanical linkage between the steering and wheels. Instead, steering inputs from the driver are converted into electronic signals, which are then processed by the vehicle's computer system to control the wheels' direction that articulate the vehicle's trajectory. This transformation promises an ultra-responsive, smoother, and more efficient steering experience, a development bound to change how we drive.

This technology allows for a highly responsive steering experience, adapting to speed, driving conditions, and potentially even driver preferences.

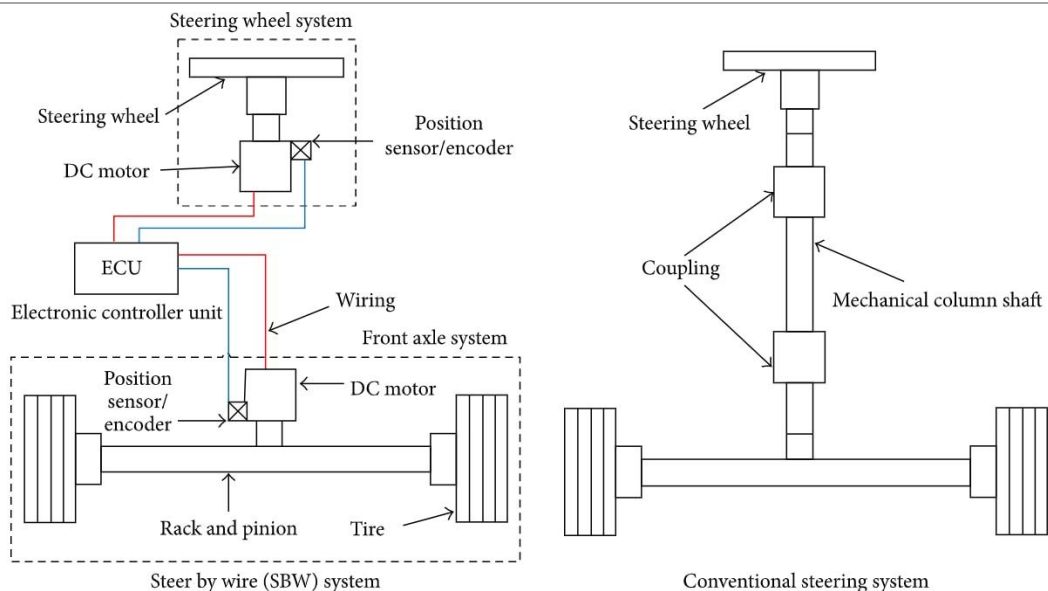
One key benefit is the potential to speed up production by reducing the number of parts needed for the steering mechanism. Additionally, the drive-by-wire technology promises a smoother ride, as the steering wheel is no longer directly connected to the road, minimizing vibration and pull-on uneven surfaces.

**Exhibit 8: Steer-by-wire technology eliminates the mechanical linkage between the steering and the wheels**



Source: Mando SbW, Elara Securities Research

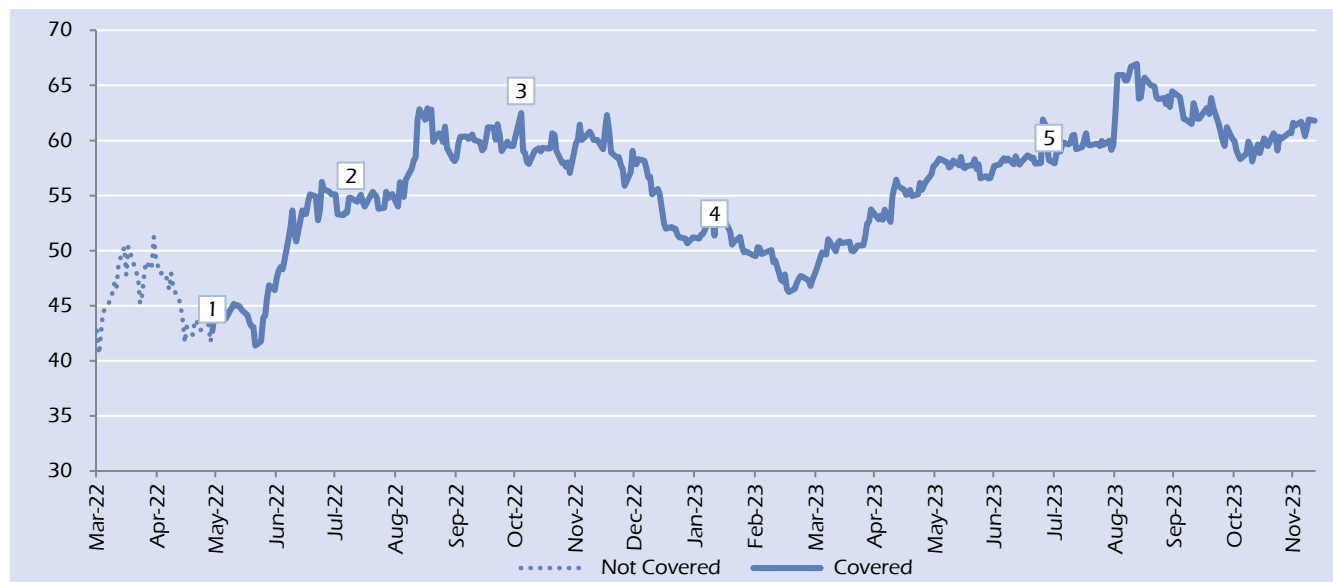
**Exhibit 9: Steer-by-wire system vs a traditional mechanical system**



Source: notateslaapp.com, Elara Securities Research

## Coverage History

### Motherson Sumi Wiring India



	Date	Rating	Target Price	Closing Price
1	26-May-2022	Buy	INR 81	INR 62
2	5-Aug-2022	Reduce	INR 81	INR 79
3	31-Oct-2022	Sell	INR 81	INR 88
	11/16/2022#	Sell	INR 58	INR 60
4	7-Feb-2023	Reduce	INR 55	INR 52
5	28-Jul-2023	Reduce	INR 57	INR 59

\*Bonus 2:5

## Guide to Research Rating

<b>BUY</b>	Absolute Return >+20%
<b>ACCUMULATE</b>	Absolute Return +5% to +20%
<b>REDUCE</b>	Absolute Return -5% to +5%
<b>SELL</b>	Absolute Return < -5%

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